Meeting Agenda

CALFED Bay-Delta Program
Water Quality Technical Team
Wednesday, October 2, 1996: 1 to 4:30 PM
Room 1412-- Resources Building
1412 Ninth Street, Sacramento, California

Agenda

1. Introductions of attendees
2. How water quality team fits into CALFED process (Steve Yaeger, 15 min.)
3. Water quality team mission and decision-making schedule (Ron Ott, 15 min.)
4. Parameters of concern

   Definition of a parameter of concern, as well as rationale and linkages for each parameter

   - Agricultural (John Dickey) 30 min.
   - Ecological (Carol Howe) 30 min.
   - Urban (John Gaston) 30 min.

   Identify, clarify, and log issues related to parameters -- for consideration by sub-teams (all, 30 min.)

4. Break (15 min.)
5. Preliminary grouping of actions based on advantages and constraints (Ron Ott)

- Define categories and explain criteria for grouping (15 min.)
- Group actions into retained for low-, moderate, and high-potential categories. Rationale groupings. (30 min.)
- Discussion (30 min.)

Agricultural Water Quality Parameters of Concern

Definition of Parameter of Concern

Characteristics of irrigation water that significantly influence sustainable agricultural production or O&M of irrigation facilities and on-farm systems.

Parameters List

Linkages

To leaching of irrigated land (Terry Prichard)

To water supply (Lance Johnson and Bob Herkert)

To drainage volume, load/flow/concentration relationship (Bill Johnston)

Geographic Extent (Nigel Quinn)

Export and source areas affected by CALFED actions:

- Sacramento Basin
- San Joaquin Basin
- Tulare Lake Basin
- Southern California
- Other export areas

Timing (Jim Beck)

Irrigation water export and application takes place year-round, so that parameter levels are always important.

D-032871

Historical Data (Rick Woodard)

For existing, representative, monitoring stations from DWR and USBR

System Location	*Monitoring Station Name*
Inflow to Delta:	
Upstream San Joaquin River	Crow's Landing
San Joaquin River IN	Vernallis
Sacramento River IN	Green's Landing
Within Delta:	
Western Delta	Jersey Point
Eastern Delta	Little Connection Slough at Empire Tract
South Delta	Middle River at Victoria Canal
Export from Delta:	
SWP OUT	Banks Pumping Station
CVP OUT	Tracy Pumping Plant
Contra Costa WD OUT	Rock Slough
Export Areas:	
SWP leaving O'Neill Forebay	Check 13 on California Aqueduct
DMC inflow to SWP	Check 9 on DMC
SWP to Southern California	Edmonston (Check 41 on California Aqueduct)
CVP water arriving at Mendota Pool	Check 20 on DMC

D-032872

Parameters of Concern And Their Effects on Agricultural Water Quality		
Parameters	**Rationale**	**Sources**
Salinity (TDS & EC)	In general, salts influence plant growth by depriving the roots of water. In agronomic systems saline conditions can translate into potential yield reduction. Crops vary in their tolerance of salinity. Many of the highest value crops are the most sensitive.	Mineral weathering, irrigation water, seawater. Saline lands and shallow groundwater, are intermediate repositories, not sources.
SAR (Sodium relative to calcium and magnesium)	Elevated SAR levels in irrigation water can degrade soil structure and reduce permeability, making water and crop management difficult. Sodium as such can be toxic to sensitive (woody) plants.	Mineral weathering, irrigation water, seawater. Subsurface drainage waters are usually enriched in sodium.
Chloride	Elevated levels of chloride reduce plant vigor and yield. As with sodium, woody plants (fruits and nuts) are especially susceptible.	Mineral weathering, irrigation water, seawater. Subsurface drainage waters are sometimes enriched in chloride.
Boron	Surface waters usually do not contain boron at toxic levels. Plant stress and yield reduction are potential hazards. Leaching boron can require two to three times the water needed to leach other salts.	Geologic, groundwater
pH	Influence tendency of low-volume irrigation systems to plug with precipitate. Precipitate may also reduce quality of greenhouse production.	Mineral balance in water
Turbidity	Increases maintenance requirements on conveyance and application infrastructure due to siltation and plugging. Accelerates loss of reservoir capacity and increases dredging costs..	Delta & tributary watersheds during flood events
Nutrients (Nitrate)	Nutrients in irrigation water can provide fertilizer benefits. However, excessive fertilization can cause excessive vegetative growth and reduce yield or quality of certain crops.	Municipal wastewater, agricultural drainage
Temperature	Low water temperatures reduce rice seedling emergence and crop development	Solar energy

Meeting Dates

CALFED Bay-Delta Program
Water Quality Technical Team

Wednesday, October 2nd, Room 1412
Team Meeting

Wednesday, October 23rd, Room 1206
Team Meeting

- program issues
- Std + Com limits
- Actions Grouping
- Critical Ranges

Wednesday, November 20th, Room 1206
Team Meeting

1 - 5

Tuesday, November 26th, TBD
Workshop

1 - 5

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D-032877

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Parameter of Concern

A parameter is of concern to ecosystem water quality providing that:

- Reliable data on the parameter shows:

  concentrations exceed established criteria for the applicable medium (e.g. water, sediment, or tissue) and;

  the exceedances are of a frequency, duration or magnitude that, in the best judgment of the ecosystem water quality sub-team, may likely result in adverse impacts to biota inhabiting or using the Delta aquatic ecosystem.

- Chronic or acute toxicity in bioassays is attributable to a parameter based on a toxic identification evaluation (TIE).

- Research/special studies provide evidence of behavioral, physiological, or reproductive impacts associated with a "parameter".

- A problem is generally recognized by the resource and regulatory agencies.

Criteria

Criteria used to determine exceedances will be based on one or more of the following, as appropriate:

- Central Valley or San Francisco Bay Water Quality Control Plan objectives (including narrative objectives), US Environmental Protection Agency water quality criteria, or CA Department of Fish and Game hazard assessment criteria;

- California Department of Health Services Maximum Contaminant Levels;

- California Department of Health Services Public Health Advisories;

- National Oceanic and Atmospheric Administration sediment guidelines and US EPA sediment quality criteria;

- National Academy of Science guidelines;

- Inland Surface Waters and Enclosed Bays and Estuaries plans (if adopted for California);

- Other criteria developed by regulatory bodies in response to local water quality problems (i.e. US EPA Great Lakes standards, Se standards in San Francisco Bay).

D-032881

CALFED Bay-Delta Water Quality Parameters of Concern

Ecosystem Water Quality

Metals

- Cadmium
- Copper
- Mercury
- Selenium
- Zinc

Organics/Pesticides

- Carbofuran
- Chlordane
- Chlorpyrifos
- DDT
- Diazinon
- PCBs
- Toxaphene

Other

- Ammonia
- Dissolved Oxygen
- **Salinity (TDS, EC)**
- **Temperature**
- **Turbidity**
- Unknown Toxicity

Metals

Cadmium, Copper, Zinc, Mercury

Source: Sacramento River

- Primary -Inactive and abandoned mine discharges
- Secondary - Urban runoff
  Cu - Brake pads, root control
  Hg - Atmospheric deposition

  NPDES discharges

  Agricultural drainage

Selenium

Sources: San Joaquin River System, In-Delta

- Primary - Agricultural drainage

  Refineries

D-032883

Metals

Cadmium, Copper and Zinc

Acute toxicity: high levels > fish kills over short periods

Chronic toxicity: low levels >Growth and physiological problems

Water quality objectives frequently exceeded during wet season downstream of Keswick Dam

Mercury and Selenium

Can biomagnify throughout food chain

Mercury

Problem from Colusa through Delta
Exceed EPA criteria 20-30% of time during high flows

Selenium

High levels detected in tissues of fish collected on San Joaquin River
Reproductive effects on wildlife

Pesticides

Organochlorine Pesticides- Chlordane, DDT, Toxaphene

Source: Banned from use in CA - remain persistent in environment

- Primary - Sediment
- Secondary - Overland runoff

Organophosphate Insecticides - Carbofuran, Chlorpyrifos, Diazinon

Source: Found throughout Central Valley system

- Primary - Agricultural and Urban Runoff

  Diazinon - Structural pest control, almonds
  Chlorpyrifos - Structural pest control, almonds, alfalfa, walnuts
  Carbofuran - alfalfa , grapes, rice

- Secondary - *Chlorpyrifos* - flea dips
  Diazinon -peaches, alfalfa
  Potentially NPDES discharges

PESTICIDES

DDT, Toxaphene and Chlordane

Bioaccumulative
Periodically detected in fish tissue throughout basin - may cause mortality to fish eggs and fry, impair reproduction

Carbofuran, Chlorpyrifos, Diazinon

Degrade rapidly but by-products may be toxic

Levels of diazinon frequently exceed criteria set to protect aquatic life

Chlorpyrifos concentrations in San Joaquin Basin frequently exceed LC50 levels for Ceriodaphnia

Diazinon and chlorpyrifos concentrations result in reduction in abundance of sensitive invertebrates (fish food)

Carbofuran concentrations exceed concentrations that are known to cause problems to Ceriodaphnia (in Delta back sloughs)

Organochlorine Compound

PCBs

Source: Banned from use in 1977 - remain persistent in environment (approximately 1/4 of production still in service - transformers and capacitors)

- Primary - Sediment
- Secondary - Airborne deposition

Bioaccumulate and biomagnify throughout food chain

Chronic effects to liver and reproductive systems of mammals

D-032887

Other Parameters

Ammonia

Dissolved Oxygen

Salinity

Temperature

Turbidity

Unknown Toxicity

DRINKING WATER QUALITY ISSUES

- Source Protection
- Sea Water Intrusion
- Agricultural Drainage
- Municipal Waste Discharges
- Local Runoff
- Recreational Boating
- Protozoan Parasites
- Pesticides
- Metals - As, Cd, Pb, Cr, Fe, Cu

D-032889

INTAKE LOCATIONS

- North Bay Aqueduct - Barker Slough
- Contra Costa Canal - Rock Slough
- California Aqueduct
  - South Bay Aqueduct
  - San Luis Reservoir
  - Southern California
- Delta Mendota Canal
- In - Delta Uses - Islands

D-032890

CONSTITUENTS OF CONCERN

- Turbidity - local impacts
- Total Organic Carbon
  - Peat Island Drainage
  - Mineral Soil Island Drainage
  - Watershed Contribution
- Bromide
  - Bromate
  - Other Brominated By-Products
- *Giardia and Cryptosporidium*
- Total Dissolved Solids
  - Sodium
  - Taste Impacts

D-032891

WATER TREATMENT TECHNOLOGY

- Reduce TOC
  - Enhanced Coagulation
  - GAC Filtration
- Disinfection
  - Chlorine
  - Chloramine
  - Ozone
- Existing Water Treatment Facilities
  - North Bay Aqueduct
  - Contra Costa Canal
  - California Aqueduct
  - Delta Mendota Canal
  - Island Systems

D-032892

Water Quality Actions	Potential		
	High	Moderate	Low
1. Reduce the concentration of pollutants entering the Delta and its tributaries during low flow periods by **altering the timing of agricultural drainage discharge** from the San Joaquin Valley to better match discharges with dilution flows. Priority given to those lands with costly and severe drainage problems.			
2. Reduce the concentration of pollutants entering the Delta and its tributaries during low flow periods by acquiring dilution water (50,000 to 100,000 acre-feet) **from willing sellers**. Action primarily targeted at San Joaquin River.			
3. Reduce the concentration of pollutants entering the Delta and its tributaries during low flow periods by acquiring dilution water (50,000 to 100,000 acre-feet). Water would be acquired by **providing incentives for more efficient water management of dams, including reservoir re-operation**. Action is primarily targeted at San Joaquin River.			
4. Reduce the concentration of pollutants entering the Delta and its tributaries during low flow periods by acquiring dilution water (50,000 to 100,000 acre-feet) through **urban water conservation**. Action is primarily targeted at the San Joaquin River. Conservation might be achieved through use of incentives for implementation of BMPs by more suppliers and water users. Implementation of the action would reduce demand for existing water and may make dilution water available (including transfers), especially on San Joaquin River.			
5. Reduce the concentration of pollutants entering the Delta and its tributaries during low flow periods by acquiring dilution water (50,000 to 100,000 acre-feet) through **wastewater reclamation**. Action is primarily targeted at the San Joaquin River. Reclamation projects could include: recharging groundwater, using for agricultural irrigation, recycling and treating for potable or non-potable urban use, use of grey water, and storage for use in meeting X2 standards. Reclamation programs would focus on facilities that currently discharge treated wastewater to salt sinks or other degraded bodies of water that are not reusable.			
6. Reduce the concentration of pollutants entering the Delta and its tributaries during low flow periods by acquiring additional dilution water through **treatment and recycling of agricultural drainage**. Recycled water would be used for irrigation purposes to reduce export demand where feasible while maintaining appropriate salt leaching requirements. Additional water would be used for dilution, especially on the San Joaquin River.			
7. Reduce the concentration of pollutants entering the Delta and its tributaries during low flow periods by acquiring additional water through **development of additional groundwater supplies**. Water would be used for dilution, especially on San Joaquin River.			
8. Improve water circulation in the Delta by **development of improvements at the head of Old River** to block fish movement into Old River and by **management of water flow and stage down Old River**.			
9. Reduce vulnerability of Delta water quality to salinity intrusion through **implementation of the Delta Long-term Protection Plan (including levees O&M)**.			
10. Reduce surface water concentrations of pesticides, concentrated mineral salts, and microbial agents by increased **enforcement of source control regulations for agricultural drainage**. Action may include; restriction of spraying adjacent to waterways, reduction in runoff volumes, reduction in concentration of pollutants in runoff and reduction in leachate concentrations and volumes.			
11. Reduce surface water concentrations of pesticides, concentrated mineral salts, and microbial agents by **expansion and extension of existing agricultural source control programs**. Action may include provision of incentives or other means to modify field drainage systems to reduce drainage volumes, manage irrigation tailwater to reduce pesticide residues, adopting BMPs to reduce rainfall induced discharge of pesticides to watercourses, higher water use efficiency to reduce the amount of agricultural drainage and reduced agrochemical loading, use of Efficient Water Management Practices (EWMPs) or expansion of existing EWMPs by more suppliers and water users.			

Water Quality Actions	Potential		
	High	Moderate	Low
12. Reduce the loading of salts and other trace elements by provision of a high-quality irrigation water supply to agriculture.			
13. Reduce surface water concentrations of pesticides, concentrated mineral salts, and microbial agents by provision of incentives for retirement or fallowing of lands (especially during drought). Action targeted at San Joaquin Valley and Delta lands that contribute to drainage problems on the San Joaquin and/or detrimental water quality problems within the Delta. Areas targeted would be those with the most severe drainage problems and where most cost effective. Action would also reduce demand for irrigation water. Under this program CALFED would establish a program to retire, by compensated purchase, marginally-productive (and voluntarily retired by landowners) agricultural lands that have drainage problems.			
14. Reduce surface water concentrations of pesticides, concentrated mineral salts, and microbial agents by concentration and disposal of agricultural drainage water through evaporation ponds to control agricultural drainage.			
15. Control agricultural drainage by treating drainage in constructed wetlands. Treatment will allows some filtration and reduction in biological oxygen demand. Action is primarily targeted at Delta agricultural drainage. Wetlands treatment would be initiated as a npilot programn to establish its feasibility and expanded appropriately.			
16. Control agricultural drainage by treating 20 to 30 percent of the drainage by means such as reverse osmosis and then recycling or augmenting river flows with the treating water.			
17. Reduce urban and industrial constituent loadings to the Delta by detention and strategic release of 20 to 30 percent of runoff water. Highest priority are areas contributing largest loadings of pollutants of concern.			
18. Reduce urban and industrial constituent loadings through enforcement of existing source control regulations for urban and industrial runoff. Measures used may include use of real economic penalties.			
19. Reduce urban and industrial constituent loadings through provision incentives for additional source control of urban and industrial runoff.			
20. Reduce urban and industrial constituent loadings through better planning of new developments to reduce urban and industrial runoff. Methods may include			
21. Focus on point and non-point source control and habitat restoration through coordination and/or development of incentives with ongoing watershed management programs that promote and protect Delta water quality and fisheries. Geographic focus includes programs both inside and outside the Delta that contribute to or are able to mitigate problems within the Delta. Watershed management programs should			
22. Reduce tributary and Delta heavy metals loadings by implementation of moderate on-site mine drainage remediation measures developed in site-specific studies at the Walker, Malakoff Diggins, Leviathon, Iron Mountain and Penn mine site and control runoff from these and other high priority mine sites based on current water quality objectives for pollutants Fund remediation through pollution-credit trading (i.e., reduce loading from mines in-lieu of more costly, but less effective wastewater treatment plant upgrades) or other means.			
23. Control discharges of domestic wastes from boats within the Delta and its tributaries by more extensive enforcement of existing regulations.			
24. Reduce loadings of pollutants to the Delta by treatment of a portion of upstream municipal wastewater effluent in wetlands.			
25. Reduce point source pollution through control of industrial and municipal wastewater treatment discharges in a cost-effective manner. Methods may include encouragement of pollution credit trading.			

D—032894

Water Quality Actions	Potential		
	High	Moderate	Low
26. Reduce concentrations of disinfection byproduct precursors (DBPs) by provision of **incentives for phased conversion of municipal wastewater treatment facilities** that produce large concentrations of DBPs to processes that do not produce DBPs.			
27. Reduce point source pollution through control of industrial and municipal wastewater treatment discharges. Methods may include **incentives for reclamation and reuse of industrial and municipal wastewater.**			
28. Improve source drinking water quality through provision of **incentives for filtration system upgrades** to meet EPA Drinking Water Quality Standards. Prioritize recipients may be targeted using criteria that includes number of service connections and upgrade costs needed to meet Maximum Contaminant Level Goals.			
29. **Improve riparian habitat** through restoration of riverine channel features including riparian vegetation **on the Sacramento River (including tributaries)** upstream of the Delta.			
30. **Improve riparian habitat** through restoration of riverine channel features in the **San Joaquin River (including tributaries)** upstream of the Delta. Work would include restoration of channel configurations on 25 to 35 miles of degraded San Joaquin River to deepen the channel and improve water temperatures.			
31. Identify potential toxicity in water and sediment through **toxicity testing and toxicity identification evaluations** or other appropriate methods.			

D—032895

Action No.	Advantages	Constraints
1	- Better match releases to assimilative capacity of river and reduce constituents during holding period (load and concentration) (Ag) - Increased compliance with Vernalis standards (Ag) - May decrease concentrations of diazionon and chlorpyrifos with increased holding time, depending on seasonality (Eco) - May decrease concentrations of diazinon and chlorpyrifos with increased holding time, depending on seasonality (Eco) **Parameters Impacted** **Positive:** Chlorpyrifos, diazinon, salinity (Eco) *NOTE: Water should come from users (those with drainage, not others)*	- Periods of sufficient assimilative capacity may be infrequent (Ag) - Cost of construction, maintenance, monitoring of holding ponds (Ag) - Potential impacts to wildlife using ponds (Ag) - Salinization of water supply and soil due to recycling, Sustainability of agriculture (Ag) - Reduced water quality during periods of discharge (Ag) - Reduces flows during holding period (Ag) - Limited interest of non-source areas (e.g. east-side San Joaquin Tributaries) (Ag) - 40 to 50 percent (can't put numbers to without more information, timing, volume, etc) should be removed (Ag) - Volume that can be withheld will depend on timing, etc. (Ag)
1	(Continued)	- Economic (Eco) - Unintended consequences (Movement to other media, groundwater contamination) (Eco) - Feasibility-pumping (Eco) - Creation of attractive nuisances for wildlife (Eco)j - Increased chemical usage for pond maintenance (Eco) - Concentration of pollutants in pond sediments (Eco) - Discharge of either tile drain or island drain water that impacts any of the water supply intakes is seen as a detriment to the extent that drainage water must be discharged, best done under the highest flow conditions possible, not low flow (Urban) **Parameters Impacted** **Negative:** Chlorpyrifos, diazinon (Eco)

Action No.	Advantages	Constraints
2	- Dilution (Ag) - Less salt delivered to ag, less salt delivered to the SJ River (Ag) - Reduced drainage load/flow (Ag) - Additional inflow to the Delta will decrease salinity (Ag) - No reason to believe that this action will do anything to reduce the TOC and source of water listed in Actions 2-5 do not appear to matter because this is the same water that is currently flowing into the Delta (Urban)	- Willing sellers may be difficult to find, Limited interest of non-source areas (e.g. east-side San Joaquin Tributaries) (Ag) - Socioeconomic impacts of water loss (Ag) - No reason to believe that this action will do anything to reduce the TOC and source of water listed in Actions 2-5 do not appear to matter because this is the same water that is currently flowing into the Delta (Urban) **Parameters Impacted** **Positive:** DO, salinity, temperature (Eco)
3	- Dilution (Ag) - Incentive programs can be attractive (Ag) - Efficiency may cause less land to be fallowed (Ag) - More water available, less drainage (Ag) - May decrease turbidity depending on dam operation (Eco) - Additional inflow to the Delta will decrease the salinity, and reduce the Br. Would be advantageous to the supplies in the southern and central Delta (CCC, CAL, DMC)(Urban) **Parameters Impacted** **Positive:** Turbidity, DO, salinity (Eco)	- Limited interest of non-source areas (e.g. east-side San Joaquin Tributaries) (Ag) - Water gained through efficiency may be used internally and not be available for downstream dilution (Ag) - Reduced opportunities for drainage water reuse (Ag) - Potential for increased water use efficiency limited (Ag) - Concentrations of parameters of concern will increase in subsurface drainage water (Ag) - Cost (Ag) - May increase turbidity depending on dam operation (Eco) - No reason to believe that this action will do anything to reduce the TOC and source of water listed in Actions 2-5 do not appear to matter because this is the same water that is currently flowing into the Delta (Urban) **Parameters Impacted** **Negative:** Turbidity (Eco)

Action No.	Advantages	Constraints
4	- Dillution (Ag) - Less runoff (Ag) - Reduced costs at treatment plants (Ag) - May decrease diazinon, chlorpyrifos, and ammonia (nitrogen products from lawn fertilizers) concentrations (Eco) - No reason to believe that this action will do anything to reduce the TOC and source of water listed in Actions 2-5 do not appear to matter because this is the same water that is currently flowing into the Delta (Urban) **Parameters Impacted** **Positive:** Ammonia, chlorpyrifos, diazinon (Eco)	- Administrative cost of urban conservation program)Ag) - Increasing urban use due to increasing population is not addressed (Ag) - Reduction of ammonia, chlorpyrifos, and diazinon dependent upon level of outdoor water conservation; increased water demand associated with growth of urban areas may constrain the effectiveness of this action (Eco) - No reason to believe that this action will do anything to reduce the TOC and source of water listed in Actions 2-5 do not appear to matter because this is the same water that is currently flowing into the Delta (Urban)
5	- Dilution (Ag) - Potential for reduced nutrient loading to tributary streams and thereby to agriculture (Ag) - Cost savings for cities from reduced flow to treatment plants (Ag) - Public awareness of water management (Ag) - Unclear (Eco) - More information needed on this action (Urban) - Will reclaimed water be added to the Delta? If so, Delta Protection Act has to be changed because the addition of reclaimed water to the Delta is currently prohibited. If it is anticipated that Sacramento or Redding would develop reclamation, the flow question will be a wash because their treated wastewater is currently discharged to the Sacramento River and provides inflow to the Delta. It is a stated policy that reclaimed water is to be encouraged to provide more freshwater and to the extent that the reclamation takes place outside of the Delta. (Urban)	- Costs may be prohibitive ($2,000/acre-foot) (Ag) - Quality (TDS) inferior to current irrigation water, unsuitable for many crops (Ag) - Limitations on crops grown also depends on level of treatment and public perception (Ag) - Other water quality concerns (e.g. metals) (Ag) - Discharge requirements will determine cities' interest (Ag) - Would need to replace existing demands to provide fresh dilution water (Ag) - Probably unacceptable to irrigators with existing contracts/water rights (Ag) - Additional salt load to groundwater and drainage requirements (Ag) - Projects require public acceptance (Ag) - Economic (Eco)

Action No.	Advantages	Constraints
6	- Dilution (Ag) - Reduces load (Ag) - Creates new water supply (Ag) - Facilitates handling of drainage water (Ag) - Decreased concentrations of listed parameters (Eco) - Agricultural drainage from Sacramento and SJR and within the Delta currently provide inflow (Urban) - Drainage could be treated from the Delta islands to reduce the TOC (Urban) - Potential water quality benefit to all supplies listed (Urban) **Parameters Impacted** **Positive:** Selenium, chlorpyrifos, ammonia, salinity (Eco)	- May not be economical ($1,500/acre-foot, minimum) (Ag) - Byproducts (sludge, brine), and cost of disposal (Ag) - Treated water may be consumed by local entitites (Ag) - High cost for desalination of water (Ag) - RO does not sufficiently reduce concentrations of trace elements like boron, unless all salts are removed (Ag) - Relies on unproven technologies (Ag) - Need to better define "treating" (Eco) - Economic (Eco) - Not a new supply (Urban)
7	- Dilution (Ag) - Same as answer to Actions 2-5 (Urban) - If we were to develop groundwater in the Sacramento Valley and use it to supplant surface water, this would be a benefit (Urban)	- High salinity of groundwater relative to current surface water supply (area-specific) (Ag) - Expense and limited lifetime of wells (Ag) - Potential degradation of groundwater by overpumping of some areas (Ag) - Lack of available groundwater; groundwater quality may be worse than surface water quality (Eco)

Action No.	Advantages	Constraints
8	- Improves operating ability of existing pumps by providing better control over SJR component of flow (Ag) - Changes distribution of salt in south and central Delta (may be constraint for some, depending on distribution of effects) (Ag) - Possible improved water quality in the rest of the Delta (Eco) - Without modeling info, it is difficult to predict an impact from this action (Urban) - To the extent that this would improve water quality on the southern and central Delta (Urban) **Parameters Impacted** **Positive:** DO, salinity, Turbidity (Eco)	- Management of weirs, gates, control sturctures (Ag) - May affect stage and farmers' ability to pump (Ag) - Applies to South Delta facilities; selenium that currently is exported south will not be captured in the Delta (Eco) - Problems with chlorpyrifos and carbofuran in Old River may be exascerbalted locally, but improved in the rest of the Delta (Eco) - Increased sedimentation and therefore DDT, toxaphene, chlordane, PCBs (Eco) - Increased export of organochlorines to the estuary because they are no long transported south (Eco) - Questionable impacts (Eco) - If it serves to redirect more saline water to the CCC, CAL, and DMC (Urban) - It will have no impact on the NBA (Urban) **Parameters Impacted** **Negative:** Selenium, carbofuran, chlorpyrifos, DDT, PCBs, toxaphene, unknown toxicity (Eco)
9	- *Defer to system vulnerability group (Ag)* - Protect Delta and export water quality (Ag) - Reduced levee erosion (Ag) - Removal of pollutants; all noted parameters may be a benefit or a constraint (except salinity) (Eco) - Improvements to the Delta levee system serve to improve reliability of supply throughout the Delta (Urban) **Parameters Impacted** **Positive:** Cadmium, Copper, mercury, selenium, zinc, salinity (Eco)	- Funding of long-term maintenance (Ag) - All noted parameters may be constraints; applies to within Delta dredgings only (Eco) - Resuspension of pollutants (Eco) - Location/Placement of levees (Eco) - Salinity content of dredgings (Eco) - Look at impact on the CCC when Andrus Island flooded following a levee break and the total dissolved solids dramatically increased in the CCC (Urban) **Parameters Impacted** **Negative:** Chlordane, DDT, PCBs, toxaphene, turbidity, unknown toxicity (Eco)

Action No.	Advantages	Constraints
10	- *Note: Outside of pesticide regulations, unsure who administers existing source control regs and what they are (Ag)* - Less herbicide/pesticide in water (Ag) - Control of pesticide and other chemical applications in domestic water sources seen as a desirable goal (Urban) **Parameters Impacted** **Positive:** Carbofuran, chlorpyrifos, diazinon, unknown toxicity (Eco) *Note: Unsure who administers existing source control regs and what they are*	- Enforcement of spraying of chemicals provides no benefit to ag water quality (Ag) - May cause maintenance problems (weed control) (Ag) - May be minimal impact (Ag) - Compliance by pesticide applicators is already enforced (Ag) - Spraying adjacent to waterways is unregulated (Eco)
11	- See Action 3 for water use efficiency (Ag) - Potential economic savings (reduced chemical use) (Ag) - Potential reduction in water usage, subsurface drainage (Ag) - Increased water efficiency may decrease selenium loading if agricultural acreage remains constant; reduced soil erosion and runoff (Eco) - Incentives for additional source control apply to agricultural drainage and viewed as a benefit to domestic water supplies (Urban) **Parameters Impacted** **Positive:** Copper, selenium, chlordane, chlorpyrifos, DDT, PCBs, toxaphene, ammonia, salinity, turbidity (Eco)	- See Action 3 for water use efficiency (Ag) - Economic potential for ag chemical reduction is currently limited (Ag) - High consumer expectations of cosmetic quality of produce (Ag) - Increased concentrations of pollutants may enter waterways because a lower volume of water is being used (Eco)
12	- Subsurface and surface drainage water quality would increase, and recycling would be more feasable (Ag) - Less subsurface drainage volume and salt to S.J.River -- pumping and applying less of the saline groundwater (Ag) - Better WQ to Delta and other users (Ag) - Potential salinity reduction (Eco) - High quality irrigation water supply will also lead to a high quality domestic water supply (Urban)	- Economics may enter into it (farmers will pump groundwater if surface water pricing is not competitive) (Ag) - Depends on ionic character of water; water may be moved from one place in the Delta to another so perhaps no net (Eco) - Not enough detail as to what is meant by the action. Is high quality to be located in the Delta? (Urban)

Action No.	Advantages	Constraints
13	- Short term reduction in drainage constituent loads and volume (Ag) *NOTE: Land fallowing acreage increases during drought because of insufficient water. Additional potential for fallowing is limited. (Ag)* - Land retirement and fallowing will mean less drainage to impact the domestic supply (Urban) **Parameters Impacted** **Positive:** Selenium, chlordane, DDT, PCBs toxaphene, ammonia, salinity, turbidity (Eco) *NOTE: Land fallowing goes up during drought now because of insufficient water. Additional potential for fallowing limited*	- Possible increased loads when lands brought back into production (Ag) - Lands with drains may still produce some drainage (Ag) - Lands that are upgradient still contribute hydraulic loading to fallowed lands, contributing to drainage volume (Ag) - Socioeconomic impacts of reduced production (Ag) - Limited additional potential for additional land fallowing during droughts, when water quality benefits would be greatest (Ag) - Cost of program (Ag) - Resistance by water districts (Ag) - This is not to be used to acquire water (Ag) **Parameters Impacted** **Negative:** Chlorpyrifos, unknown toxicity (Eco)
14	- Reduction in drainage and constituent discharge to San Joaquin (Ag) - Can be combined with reuse of water (Ag) - Option was studied during Bay-Delta Hearings and is subject of an existing DWR study involving Delta islands (Urban) - Suggested that island drains nearest to intakes at NBA, CCC, CAL, and DMC be controlled through treatment or diversion to see if this would make a positive impact (Urban) **Parameters Impacted** **Positive:** Chlorpyrifos, chlordane, diazinon, DDT, PCBs, toxaphene, salinity, unknown toxicity (Eco)	- May have limited feasible application (Ag) - Requires about 20 percent of land for storage and disposal (Ag) - Standing, concentrated water an attractive nuissance (Ag) - Disposal of solids/brine is costly and may have adverse environmental impacts (Ag) - Wildlife impacts, attractive nuisances, disposal of byproducts, impacts to Pond Biota (Eco) - May not be possible to provide treatment without essentially closing out Delta agriculture (Urban) - Noted that drains directly adjacent to the NBA and CCC be shown to degrade water quality (Urban)

Action No.	Advantages	Constraints
15	- Potential for nutrient, turbidity, toxics (organics, metals, trace elements) removal (Ag) - Retention time may allow decomposition of pesticides and byproducts and settling of particulate metals; Plants may uptake dissolved metals; may improve offsite DO levels; may reduce salinity concentrations offsite (Eco) **Parameters Impacted** **Positive:** Metals? Chlordane, chlorpyrifos, DDT, PCBs, toxaphene, ammonia, DO, salinity, turbidity, unknown toxicity (Eco) (In-River): Cadmium, copper, mercury, selenium, zinc, DDT, PCBs, toxaphene, ammonia, turbidity, unknown toxicity (Eco)	- Potential toxics accumulation/bioaccumulation (Ag) - Volume cited not significant (Ag) - Pesticides may decompose into more toxic byproducts; selenium and mercury may concentrate in the wetlands; Volatile compounds (ammonia, pesticides) may cause nonpoint source emissions to the atmosphere; possible onsite problems with DO (Eco) - If conducted on Delta islands comprised primarily of peat material, will serve to further degrade the domestic supplies because the TOC will be increased (Urban) **Parameters Impacted** **Negative:** (In-Wetland) Cadmium, Copper, Mercury, Selenium, Zinc, DDT, PCBs, toxaphene, ammonia, turbidity, unknown turbidity (Eco)
16	- Beneficial reuse (Ag) - Improve WQ in SJR and improved compliance with WQ standards (Ag) - Point source control--would reduce all parameters of concern; may improve assimilative capacity of stream (Eco) - Discharge of agricultural drainage water can be kept on the islands and not discharged is seen as a benefit to domestic supplies (Urban) **Parameters Impacted** **Positive:** Cadmium, copper, mercury, selenium, chlordane, chlorpyrifos, DDT, PCBs, toxaphene, ammonia, DO, salinity, temperature, unknown toxicity (Eco)	- Boron only partially removed by R.O. (Ag) - Economically questionable (Ag) - Cost of treatment (Ag) - Disposal of salts/brine (Ag) - Recycled water likely to be locally consumed, and may not improve SJR inflow (Ag) - Cost of collection, storage, and disposal of drainage from multiple sources (brine solution with high concentrations of selenium); May decrease assimilative capacity of stream by removing water (Eco)

Action No.	Advantages	Constraints
17	- Reduces load, augments flow (Ag) - Increased retention time may decrease concentrations of diazinon and chlorpyrifos; may serve as check for mercury in nonpoint urban runoff; would help to decrease ammonia inputs from Port of Sacramento (Eco) - Extent that treated water is low in TOC, constituent of concern, is seen as a benefit to domestic supplies (Urban) **Parameters Impacted** **Positive:** Cadmium, copper, zinc, chlorpyrifos, diazinon, ammonia, DO, unknown toxicity (Eco)	- Boron only partially removed by R.O. (Ag) - Economically questionable (Ag) - Cost of treatment (Ag) - Disposal of salts/brine (Ag) - Storage for runoff water (NQ) (Ag) - Implementation costs (NQ) (Ag) - Targeted to dry weather events only (Eco) **Parameters Impacted** **Negative:** Salinity (Eco)
18	- Reduced contaminant loading (Ag) - Questionable whether mercury will be reduced (Eco) - (Dickey version) All of these would be seen as of benefit to domestic suppliers to the extent that they reduce the loading of TOC and other constituents of concern to the Delta (Urban) **Parameters Impacted** **Positive:** Cadmium, copper, mercury, zinc, chlorpyrifos, diazinon, ammonia, DO, turbidity (Eco)	- Cost of enforcement (Ag) - Little to do with agricultural water quality (Ag) - Need to clarify regulations (Eco) - Lack of enforceable mechanisms (Eco) **Parameters Impacted** **Negative:** Cadmium, copper, mercury, selenium, zinc (Eco)
19	- Reduced contaminant loading (Ag) - May allow different source control approaches (Eco) - Wet basin vs dry basin (Eco) - (Dickey version) All of these would be seen as of benefit to domestic suppliers to the extent that they reduce the loading of TOC and other constituents of concern to the Delta (Urban) **Parameters Impacted** **Positive:** Chlorpyrifos, diazinon, unknown toxicity (Eco)	- Cost of incentive program (Ag) - Little to do with agricultural water quality (Ag)

Action No.	Advantages	Constraints
20	- Less erosion, improved turbidity (Ag) - Less nutrients on runoff (Ag) - Long-term cost savings (i.e., less flooding problems) (Eco) - (Dickey version) All of these would be seen as of benefit to domestic suppliers to the extent that they reduce the loading of TOC and other constituents of concern to the Delta (Urban) **Parameters Impacted** **Positive:** Cadmium, copper, mercury, selenium, zinc, chlorpyrifos, diazinon, unknown toxicity (Eco)	- Cost of program (Ag) - Little to do with agricultural water quality (Ag) - Cost (Eco) - Difficult to construct passive systems (green belts) in established communities (Eco) - County reluctance to maintain green belts (Eco) - Wetlands designed to treat and trap pollutants may allow percolation of pollutants to groundwater (Eco) **Parameters Impacted** **Positive:** Cadmium copper, mercury, selenium, zinc (Eco) *NOTE: Economic incentives needed to encourage consideration of green belts in early stages of development (Eco)*
21	- Reduced contaminant loading (Ag) - Salinity associated with tidal marshes (Eco) - May decrease ammonia concentration by converting grazing lands (Eco) - Reclamation is seen as beneficial (Urban) - Upstream counties--sedimentation and existing water quality above existing reservoirs (Eco) - If new developments can be put into place without adversely impacting the discharge situation currently exists there would be no reason for restrictions (Urban) - Limit additional discharge (Urban) **Parameters Impacted** **Positive:** DO, salinity, turbidity (Eco), Needs further clarification (Eco)	- Implementation cost (NQ) (Ag) - Little to do with agricultural water quality (Ag) - Must provide incentive outside Delta also (JM) (Ag) - Need to develop agricultural BMPs to limit pesticide impacts to water quality (Eco) - All supplies derived from Delta are filtered. Two technologies that utilities are currently investigating are ozone for disinfection and enhanced coagulation for reduction of TOC. Both improve water quality at consumers tap at substantial cost. Next treatment step, installation of GAC is more than an order of magnitude increase in cost (Urban)

Action No.	Advantages	Constraints
22	- Cantua Creek and Silver Creek (concentrated contaminant sources) are candidate watersheds (Ag) - Addressing upper watersheds will have long-term benefits (Ag) - Will help control sediment loadings (Ag) - Reduces turbidity in Delta and aqueduct (Ag) - May augment firm yield (Ag) - Replace small, dense growth with large sparse growth, reduced consumptive use of water and destructiveness of fires (Ag) - Improved conditions for aquatic life (Ag) - Reduced levels of containments (Ag) - Net reduction in metals loading (mainly in the Sacramento River) (Eco) - Reductions nearer the sources will achieve load reductions where rivers have the least assimilative capacity (Eco) - Reduction in chemical sediments (Eco) - Watershed management efforts reduce amount of pollutants loading to Delta (Urban) **Parameters Impacted** **Positive:** Copper, cadmium, mercury, zinc, turbidity, unknown toxicity (Urban) *NOTE: Clarify pollution credit trading concept: should be "total load reduction credits". Clarify inactive versus abandoned mines (Eco)*	- Costs of implementation (Ag) - Short-term impacts (runoff from road construction, etc) associated with remediation efforts (Eco) - Liability concerns (Eco) - Difficulty to obtain resources and contracts (Eco) - Introduction of cyanide into ecosystem fro settling ponds which use cyanide to chelate metals (Eco)
23	- Defer to Urban and Municipal sub-teams (Ag) - Minimal benefits; primarily aesthetic (Eco) - Reduction of metals loading from ind rainage, regardless of source of funding will be seen as a benefit to domestic water suppliers (Urban) **Parameters Impacted** **Positive:** Ammonia, DO (Eco)	- Defer to Urban and Municipal sub-teams (Ag)

Action No.	Advantages	Constraints
24	- Defer to Urban and Municipal sub-teams (Ag) - Possible creation of wildlife habitat (Eco) - Lower cost than conventional tertiary treatment (Eco) - Important in the immediate vicinity of intake structures at NBA, CCC, CAL, & DMC, and in the vicinity of marinas where there may be local water supplies (Urban) **Parameters Impacted** **Positive:** (In-stream) Cadmium, copper, mercury, zinc, chlorpyrifos, unknown toxicity (Eco)	- Defer to Urban and Municipal sub-teams (Ag) - Requires large amounts of land (may be unavailable in urban areas or costly) (Eco) - May create an attractive nuisance for wildlife by accumulating toxic substances (Eco) - Salinity and ammonia may accumulate--source to rivers (Eco) - Pollutant percolation to groundwater (Eco)
25	- Defer to Urban and Municipal sub-teams (Ag) - Only benefits system if net loads are reduced (Eco) - Items needs explanation; are we constructing wetlands to treat municipal wastewater in conjunction with agricultural drainage? If wetlands treatment results in higher TOC loading it will be seen as detriment; if results in lower TOC loading, it will be seen as benefit (Urban)	- Defer to Urban and Municipal sub-teams (Ag) - Overall net loads need to be reduced (Eco)
26	- Defer to Urban and Municipal sub-teams (Ag) - Use of carbon columns may reduce pesticide loads to streams; reduction in toxicity associated with residual chlorine levels (Eco) - Needs more explanation; what is a specific example of process. Any action that serves to reduce the TOC loading to domestic supplies will be seen as a benefit (Urban) **Parameters Impacted** **Positive:** Pesticides, unknown toxicity (Eco)	- Defer to Urban and Municipal sub-teams (Ag)

Action No.	Advantages	Constraints
27	- Defer to Urban and Municipal sub-teams (Ag) - May increase assimilative capacity of receiving stream (Eco) - Unless we are able to limit the TOC loading to domestic supplies it will not be able to be detected in intake areas. (Urban) **Parameters Impacted** **Positive:** Chlorpyrifos, unknown toxicity (Eco)	- Defer to Urban and Municipal sub-teams (Ag) - May decrease assimilative capacity of receiving stream by removing water and consequently increasing concentrations of pollutants (Eco) *NOTE: Replace "reclamation" with "wastewater"; mention alternatives--ozonation*
28	- Defer to Urban and Municipal sub-teams (Ag) - Not much impact (Eco) **Parameters Impacted** **Positive:** Unknown toxicity (Eco) *NOTE: Upstream turbidity issues* (Eco)	- Defer to Urban and Municipal sub-teams (Ag) - Not much impact (Eco)
29	- Defer to Urban and Municipal sub-teams (Ag) - All of these actions can be viewed as either benefit or neutral. If riparian habitat restoration on the tributaries to Delta prevents restoration pressure at the intakes, a benefit (Urban) **Parameters Impacted** **Positive:** Ammonia, DO, temperature (Eco)	- Defer to Urban and Municipal sub-teams (Ag) **Parameters Impacted** **Negative:** Chlordane, DDT, PCBs, toxaphene, turbidity (Eco) *NOTE: Needs clarification, "channel features". Is this the meandering vs. channelized nature of some streams?* (Eco)
30	- Defer to Urban and Municipal sub-teams (Ag) **Parameters Impacted** **Positive:** Temperature (Eco) *NOTE: Needs clarification: "channel features", is this the meandering vs. Channelized nature of some streams?* (Eco)	- Defer to Urban and Municipal sub-teams (Ag) - All of these actions can be viewed as either benefit or neutral. If riparian habitat restoration on the tributaries to Delta prevents restoration pressure a the intakes, a benefit (Urban) **Parameters Impacted** **Positive:** Chlordane, DDT, PCBs, toxaphene, turbidity (Eco)

Action No.	Advantages	Constraints
31	- Defer to Urban and Municipal sub-teams (Ag) - Cost effective (Eco) - All of these actions can be viewed as either benefit or neutral. If riparian habitat restoration on the tributaries to Delta prevents restoration pressure at the intakes, a benefit (Urban) - More research is always seen as a benefit to the extent that it does not divert funds from more immediate actions which will result in direct benefits (Urban) **Parameters Impacted** **Positive:** Unknown toxicity (Eco)	- Defer to Urban and Municipal sub-teams (Ag) - Cost (Eco) - Length of time needed (Eco) *NOTE: Wording of action--insert "ambient" (Eco)*